

Claims

We claim:

1. A method for simulating a product being designed, the method
5 comprising:

creating a first graphical program that models the product being designed, wherein
the first graphical program is created in a first graphical program development
environment;

deploying the first graphical program on a target device for execution;

10 creating a second graphical program that performs a measurement function,
wherein the second graphical program is created in a second graphical program
development environment, wherein the second graphical program development
environment is different than the first graphical program development environment;

coupling the target device to a physical system;

15 executing the first graphical program on the target device to simulate operation of
the product, wherein the target device interacts with the physical system;

executing the second graphical program to measure at least one of: 1)
characteristics of the operation of the physical system and/or 2) characteristics of the
operation of the product; and

20 displaying a single graphical user interface comprising a first one or more
graphical user interface elements for the first graphical program and a second one or more
graphical user interface elements for the second graphical program.

2. The method of claim 1,

25 wherein the first one or more graphical user interface elements for the first
graphical program display one or more parameters related to operation of the first
graphical program.

3. The method of claim 2,

wherein the first graphical program comprises a model of the product being designed;

wherein the one or more parameters affect operation of the model of the product being designed.

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4. The method of claim 3, further comprising:

receiving user input to one of the first one or more graphical user interface elements to adjust operation of the first graphical program during said executing the first graphical program;

10 wherein the user input operates to adjust the model of the product being designed.

5. The method of claim 1,

wherein the second one or more graphical user interface elements for the second graphical program display measured characteristics relating to at least one of: 1) operation of the physical system and/or 2) operation of the target device.

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6. The method of claim 1, further comprising:

receiving user input to one of the second one or more graphical user interface elements to adjust operation of the measurement function during said executing the second graphical program.

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7. The method of claim 1, further comprising:

coupling a first computer system to the target device;

wherein said executing the second graphical program comprises executing the second graphical program on the first computer system;

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wherein said executing the second graphical program to measure characteristics of the operation of the product comprises executing the second graphical program to measure characteristics of the target device.

8. The method of claim 7, further comprising:

displaying the single graphical user interface on a display screen of the first computer system.

5 9. The method of claim 1, further comprising:

coupling a first computer system to the physical system;

wherein said executing the second graphical program comprises executing the second graphical program on the first computer system;

wherein the second graphical program is executable to cause the first computer
10 system to interface with the physical system through one or more instruments to measure characteristics of the physical system.

10. The method of claim 9, further comprising:

displaying the single graphical user interface on a display screen of the first
15 computer system.

11. The method of claim 1,

wherein said deploying the first graphical program on a target device for
execution comprises transferring the first graphical program from a first computer system
20 to the target device;

wherein the target device is a board comprised in a slot of the first computer system.

12. The method of claim 1,

25 wherein said deploying the first graphical program on a target device for execution comprises transferring the first graphical program from a first computer system to the target device;

wherein the target device is external to the first computer system.

13. The method of claim 1,
wherein said deploying the first graphical program on the target device comprises
storing the first graphical program in a memory of the target device.

5 14. The method of claim 13,
wherein the memory of the target device stores a graphical program execution
engine for executing graphical programs created in the first graphical program
development environment;

wherein said executing the first graphical program includes executing the
10 graphical program execution engine.

15 15. The method of claim 1,
wherein said deploying the first graphical program on the target device comprises:
converting the first graphical program to machine language code; and
storing the machine language code in a memory of the target device.

16. The method of claim 1,
wherein said deploying the first graphical program on the target device comprises:
converting the first graphical program to a program in a text-based
20 programming language;
compiling the program in the text-based programming language to
machine language code; and
storing the machine language code in a memory of the target device.

25 17. The method of claim 1,
wherein the target device includes a programmable hardware element;
wherein said deploying the first graphical program on the target device comprises:
converting the first graphical program to a hardware configuration
program; and

configuring the programmable hardware element on the target device according to the hardware configuration program.

18. The method of claim 1,
5 wherein said target device interacting with the physical system comprises the target device controlling the physical system.

19. The method of claim 1,
wherein said coupling the target device to the physical system comprises coupling
10 the target device to one or more actuators coupled to the physical system;
wherein the first graphical program is executable to cause the target device to control the physical system through the one or more actuators.

20. The method of claim 1, further comprising:
15 assembling the first one or more graphical user interface elements and the second one or more graphical user interface elements on a display in response to user input.

21. The method of claim 1, further comprising:
assembling the first one or more graphical user interface elements and the second
20 one or more graphical user interface elements on a single window of a display in response to user input.

22. The method of claim 1,
wherein the first one or more graphical user interface elements are selected from
25 the first graphical program development environment; and
wherein the second one or more graphical user interface elements are selected from the second graphical program development environment.

23. The method of claim 1,

wherein the first one or more graphical user interface elements and the second one or more graphical user interface elements are selected from the second graphical program development environment.

5 24. The method of claim 1,

 wherein the first one or more graphical user interface elements and the second one or more graphical user interface elements are selected from the first graphical program development environment.

10 25. The method of claim 1, further comprising:

 creating the single graphical user interface in response to user input, wherein said creating includes selecting the first one or more graphical user interface elements from the first graphical program development environment and selecting the second one or more graphical user interface elements from the second graphical program development environment.

15 26. The method of claim 1, further comprising:

 selecting the first one or more graphical user interface elements from the first graphical program development environment;

20 creating the single graphical user interface in the second graphical program development environment, wherein said creating comprises including the first one or more graphical user interface elements selected from the first graphical program development environment in the single graphical user interface.

25 27. The method of claim 26,

 wherein said creating the single graphical user interface in the second graphical program development environment includes selecting the second one or more graphical user interface elements from the second graphical program development environment.

28. The method of claim 1,

wherein the single graphical user interface comprises a single window containing the first one or more graphical user interface elements and the second one or more graphical user interface elements.

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29. The method of claim 1,

wherein the single graphical user interface comprises a single front panel containing the first one or more graphical user interface elements and the second one or more graphical user interface elements.

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30. The method of claim 1,

wherein the first one or more graphical user interface elements comprise:

one or more graphical user interface elements for receiving user input and providing the user input to the first graphical program; and

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one or more graphical user interface elements for displaying output from the first graphical program.

31. The method of claim 1,

wherein the second one or more graphical user interface elements comprise:

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one or more graphical user interface elements for receiving user input and providing the user input to the second graphical program; and

one or more graphical user interface elements for displaying output from the second graphical program.

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32. The method of claim 1,

wherein said executing the second graphical program is performed concurrently with at least a portion of said executing the first graphical program.

33. The method of claim 1,

wherein said executing the second graphical program comprises executing the second graphical program to measure characteristics of the operation of the physical system;

wherein the measured characteristics of the operation of the physical system are
5 useful in analyzing operation of the product.

34. The method of claim 1,

wherein said executing the second graphical program comprises executing the second graphical program to measure characteristics of the operation of the product;

10 wherein the measured characteristics of the operation of the product are useful in analyzing operation of the product.

35. The method of claim 1,

wherein the first graphical program comprises a plurality of interconnected nodes
15 which visually indicate functionality of the first graphical program.

36. The method of claim 1,

wherein the second graphical program comprises a plurality of interconnected nodes which visually indicate functionality of the second graphical program.

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37. The method of claim 1,

wherein the first graphical program comprises a block diagram.

38. The method of claim 1,

25 wherein the second graphical program comprises a block diagram.

39. The method of claim 1,

wherein the first graphical program comprises one of a data flow diagram or a control flow diagram; and

wherein the second graphical program comprises one of a data flow diagram or a control flow diagram.

40. The method of claim 1,
5 wherein the first graphical program comprises one of a data flow diagram and/or a state transition diagram;
wherein the second graphical program comprises a data flow diagram.

41. The method of claim 1,
10 wherein the first graphical program comprises a Simulink diagram.

42. The method of claim 1,
wherein the second graphical program comprises a LabVIEW diagram.

43. The method of claim 1,
15 wherein the method performs a rapid control prototyping simulation.

44. The method of claim 1,
wherein the product being designed comprises a control unit for controlling the
20 physical system.

45. The method of claim 44,
wherein the second graphical program is operable to measure characteristics of the operation of the physical system;

25 wherein the measured characteristics of the operation of the physical system are useful in analyzing control of the physical system.

46. A system for simulating a product being designed, the system comprising:

a physical system;

a target device coupled to the physical system, wherein the target device is configured to execute a first graphical program that models a product being designed, wherein the first graphical program was created in a first graphical program development
5 environment;

a first computer system coupled to the target device, wherein the first computer system is configured to execute a second graphical program that performs a measurement function, wherein the second graphical program was created in a second graphical program development environment, wherein the second graphical program development
10 environment is different than the first graphical program development environment;

wherein the target device is operable to execute the first graphical program to simulate operation of the product, wherein the first graphical program causes the target device to interact with the physical system;

wherein the first computer system is operable to execute the second graphical
15 program to measure at least one of: 1) characteristics of the operation of the physical system and/or 2) characteristics of the operation of the product; and

wherein the first computer system is operable to display a single graphical user interface comprising a first one or more graphical user interface elements for the first graphical program and a second one or more graphical user interface elements for the
20 second graphical program.

47. The system of claim 46,

wherein said target device interacting with the physical system comprises the target device controlling the physical system.

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48. The system of claim 46,

wherein the first one or more graphical user interface elements for the first graphical program display one or more parameters related to operation of the first graphical program;

wherein the first graphical program comprises a model of the product being designed;

wherein the one or more parameters affect operation of the model of the product being designed;

5 wherein the system further comprises a user input device for receiving user input to one of the first one or more graphical user interface elements to adjust operation of the first graphical program;

wherein the user input operates to adjust the model of the product being designed.

10 49. The system of claim 46,

wherein the second one or more graphical user interface elements for the second graphical program display measured characteristics relating to operation of the target device;

the system further comprising:

15 a user input device for receiving user input to one of the second one or more graphical user interface elements to adjust operation of the measurement function.

50. The system of claim 46,

wherein the target device includes a processor and memory;

20 wherein the memory of the target device stores the first graphical program;

wherein the memory of the target device also stores a graphical program execution engine for executing graphical programs created in the first graphical program development environment;

25 wherein the processor in the target device is operable to execute the graphical program execution engine in executing the first graphical program.

51. The system of claim 46,

wherein the target device includes a processor and memory;

wherein the memory of the target device stores executable code created from the first graphical program; and

wherein the processor in the target device is operable to execute the executable code.

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52. The system of claim 46,

wherein the target device includes a programmable hardware element;

wherein the programmable hardware element is configured with a hardware configuration program based on the first graphical program.

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53. The system of claim 46,

wherein the single graphical user interface comprises a single window containing the first one or more graphical user interface elements and the second one or more graphical user interface elements.

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54. The system of claim 46,

wherein the first computer system is operable to execute the second graphical program to measure characteristics of the operation of the physical system;

wherein the measured characteristics of the operation of the physical system are useful in analyzing operation of the product.

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55. The system of claim 46,

wherein the first computer system is operable to execute the second graphical program to measure characteristics of the operation of the product;

wherein the measured characteristics of the operation of the product are useful in analyzing operation of the product.

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56. The system of claim 46,

wherein the first graphical program comprises a plurality of interconnected nodes which visually indicate functionality of the first graphical program.

57. The system of claim 46,
5 wherein the second graphical program comprises a plurality of interconnected nodes which visually indicate functionality of the second graphical program.

58. The system of claim 46,
wherein the first graphical program comprises a data flow diagram; and
10 wherein the second graphical program comprises one of a data flow diagram or a control flow diagram.

59. The system of claim 46,
wherein the system performs a rapid control prototyping simulation.

15 60. A method for simulating a product being designed, the method comprising:

creating a first graphical program that models the product being designed, wherein
20 the first graphical program is created in a first graphical program development environment;

deploying the first graphical program on a target device for execution;

creating a second graphical program that performs a measurement function,
wherein the second graphical program is created in a second graphical program
25 development environment, wherein the second graphical program development environment is different than the first graphical program development environment;

coupling the target device to a physical system;

executing the first graphical program on the target device to simulate operation of the product, wherein the target device interacts with the physical system;

executing the second graphical program to measure characteristics of the operation of the physical system; and

displaying a single graphical user interface window comprising a first one or more graphical user interface elements for the first graphical program and a second one or more graphical user interface elements for the second graphical program.

61. A method for simulating a product being designed, the method comprising:

10 creating a first graphical program that models the product being designed, wherein the first graphical program is created in a first graphical program development environment;

deploying the first graphical program on a target device for execution;

15 creating a second graphical program that performs a measurement function, wherein the second graphical program is created in a second graphical program development environment, wherein the second graphical program development environment is different than the first graphical program development environment;

coupling the target device to a physical system;

20 executing the first graphical program on the target device to simulate operation of the product, wherein the target device interacts with the physical system;

executing the second graphical program to measure characteristics of the operation of the target device; and

25 displaying a single graphical user interface window comprising a first one or more graphical user interface elements for the first graphical program and a second one or more graphical user interface elements for the second graphical program.

62. A method for performing a rapid control prototyping simulation, the method comprising:

creating a first graphical program that models a product being designed, wherein the first graphical program is created in a first graphical program development environment;

deploying the first graphical program on a target device for execution;

5 creating a second graphical program that performs a measurement function, wherein the second graphical program is created in a second graphical program development environment, wherein the second graphical program development environment is different than the first graphical program development environment;

coupling the target device to a physical system;

10 executing the first graphical program on the target device to simulate operation of the product, wherein the target device interacts with the physical system;

executing the second graphical program to measure characteristics of the operation of the physical system; and

15 displaying a single graphical user interface comprising a first plurality of graphical user interface elements for the first graphical program and a second plurality of graphical user interface elements for the second graphical program.

63. The method of claim 62,

20 wherein the second plurality of graphical user interface elements for the second graphical program display measured characteristics relating to operation of the physical system.

64. The method of claim 62, further comprising:

25 coupling one or more sensors to the physical system, wherein the sensors are operable to receive signals from the physical system and provide the received signals to the second graphical program.

65. The method of claim 62, further comprising:

coupling a first computer system to the physical system; and

executing the second graphical program on the first computer system.

5 66. A system for performing a rapid control prototyping simulation, the system comprising:

a physical system;

10 a target device coupled to the physical system, wherein the target device is configured to execute a first graphical program that models a product being designed, wherein the first graphical program was created in a first graphical program development environment;

15 a first computer system coupled to the physical system, wherein the first computer system is configured to execute a second graphical program that performs a measurement function, wherein the second graphical program was created in a second graphical program development environment, wherein the second graphical program development environment is different than the first graphical program development environment;

wherein the target device is operable to execute the first graphical program to simulate operation of the product, wherein the first graphical program causes the target device to interact with the physical system;

20 wherein the first computer system is operable to execute the second graphical program to measure characteristics of the operation of the physical system; and

wherein the first computer system is operable to display a single graphical user interface comprising a first plurality of graphical user interface elements for the first graphical program and a second plurality of graphical user interface elements for the second graphical program.

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67. The system of claim 66,

wherein said target device interacting with the physical system comprises the target device controlling the physical system.

68. A method for evaluating operation of a control unit being designed, the method comprising:

creating a first graphical program that models the control unit being designed, wherein the first graphical program is created in a first graphical program development environment;

5 deploying the first graphical program on a target device for execution;

creating a second graphical program that performs a measurement function, wherein the second graphical program is created in a second graphical program development environment, wherein the second graphical program development environment is different than the first graphical program development environment;

10 coupling the target device to a physical system;

executing the first graphical program on the target device to simulate operation of the control unit, wherein the target device interacts with the physical system to control the physical system;

15 executing the second graphical program to measure characteristics of the operation of the physical system, wherein the measured characteristics are useful in analyzing operation of the control unit; and

displaying a single graphical user interface comprising a first one or more graphical user interface elements for the first graphical program and a second one or more graphical user interface elements for the second graphical program.